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A Study of the Effects of Climatic Parameters on Determining Land Areas for the Cultivation of Canola in Ardabil Province Using GIS

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Abstract: In the present study, regions favorable for the cultivation of canola seeds were determined using the geographic information system. Initially, for each of climatic needs of canola, one separate layer was virtually prepared with the help of the geographic information system. These layers included the layer of rainfall throughout the growth period, layer of frost, the layers of mean minimum absolute temperature, mean maximum absolute temperature, mean maximum temperature and mean temperature of the growth period, the layer of sunshine hours and physiographical layers of the earth such as topography, slope, land use and soil depth. Finally using a combined weight factor model, the regions favorable to canola seed cultivation in Ardabil province were mapped. Based on the analysis of the final maps, the land area of the province suitable for cultivation was determined: 9.85% without any limitation, 18.36% with little restriction, 16.70% with moderate restriction, 30.66% with fairly severe restriction and 23.43% with very severe restriction.

Key words: Canola, climatic elements, factors, Ardabil Province, GIS

INTRODUCTION

One of the most important factors affecting the quality and quantity of agricultural crops during the growth and reproductive stages is the regional weather or climate. With regard to this issue, as well as the policy of the government in expanding the cultivation of oil seeds, the need for research into the climatic conditions for canola cultivation in the province of Ardabil is of top priority. The effects of the climate of each region on the quantity and quality of agricultural, farm and orchard products are profound and are among the factors affecting the economic efficiency of agriculture and provision of the food needs of the society.

With this background, an attempt has been made in this study to examine the effects of climatic elements and factors on the product canola with regard to the table of regional needs (Table 1) and to determine regions conducive to canola cultivation in the Ardabil Province. To cultivate canola, depending on the type of soil and type of plant, the depth of the soil should range between 0 and 2-5 cm. Furthermore, with the timing of the canola cultivation influenced by the temperature of the environment, the soil and humidity of soil, there is a large difference between canola cultivation in spring and canola cultivation in the fall. Mendham *et al*. (1981) demonstrated that the performance of autumn canola is a function of the spring growth and the transportation of carbohydrates from growth parts. Autumn canola have better performance and the higher percentage of oil. Ahmadi and Javidifar (1998) and Mahler (1970) reported significant reciprocal effects between canola plant types and environment in most parts so that for obtaining optimum performance the percentage of oil and quantity of oil in each region requires types with the greatest adaptability to environmental characteristics. Canola is a product of cold temperate regions. Canola like other plants and cold blooded animals reacts to temperature. Freezing days are important for canola but this factor should be examined along with the minimum absolute temperature and with regard to the type of canola so that the reciprocal effects are not misleading (Aziz *et al*., 1999). In autumn types, conditions are different and as mentioned before in this type, 6-8 weeks of cold are necessary for conversion to spring type and when these conditions are present, relative performance is increased. The fact that canola requires less water is one of its positive points. As a result it can be cultivated by two methods: dry farming and water farming. In a study, Central California to determine the water requirements in watr cultivation of canola, it was found that the amount of water required for the cultivation of canola varies between 210 and 550 mm depending on the air temperature and potential evaporation and transpiration in dry regions. The amount of water needed is between these two limits. Photosynthesis and food production in plants takes place in the presence of the sun and with the use of solar energy and is converted to chemical energy. Canola is a long day plant whose flowering is promoted as the length of the day increases: light also increases the growth of

Table 1: Climatic needs of autumn canola in dry farming

Climatic characteristics	Without restrictions	With little restriction	With moderate restriction	With fairly severe restriction	With severe restriction
Mean temperature	12/5-13/5	12-12/5	11-12	9-11	17> or <9
		13/5-14	14-15	15-17	
Mean maximum temperature	18 -19	17-18	16-17	15-16	22>or <15
		19-20	20-21	21-22	
Mean minimum temperature	6-7	5-6	4-5	4-2	10> or <2
		7-7/5	7/5-8	8-10	
Precipitation during growth	500>	400-500	300-400	200-300	<200
No. of frost days	50-60	40-50	30-40	20-30	120> or <20
		60-70	70-90	90-120	
Relative humidity	70-80	65-70	55-65	40-55	80<or 40>
Sunshine hours	>2000	1500-2000	1000-1500	800-1000	800>
Slope	0-2	2-8	8-12	12-16	>16
Soil depth	>150	100-150	80-100	60-80	60>
Type of land use	River sediment plains	Upper plateaus and terraces	Hills	Mountains	Salty land
Land use	Agricultural land	Pastures and meadows	Jungle	Water sources	Barren land

vegetation (Deshiri, 1999). Previous findings have indicated that 2000 h of sunshine is not restricting for canola.

MATERIALS AND METHODS

To analyze climatic elements climatic-agricultural zonation of the province for canola cultivation was performed in the GIS environment. The selection of East Azerbaijan for the study is of importance as this region is considered to be one of the most important agricultural centers of the country.

Examination of metrological statistics and parameters: Information regarding mean daily temperature mean minimum absolute temperature, precipitation during growth period, mean maximum temperature, frost and sunshine hours from different synoptic stations, climatology, measurement of rainfall and evaporation, as well as physiographic factors such as topography, slopes, land use, soil depth was obtained from the survey department of Jahad Agricultural Organization. Data was collected in several statistical stages from 39 stations from the time of station installation through 2005.

Preparation of different information layers from physiographic factors of the earth: To obtain the earth's digital elevation model a 1/250,000 map was used. To this end, initially by considering zones 38 and 39 represented in the UTM imaging system, all points were converted to UTM system and then a layer was prepared from the elevated points in victory format. Next, by performing interpolation by the IDW method an elevation model of the earth was prepared (Motiei, 2005).

The map of the slopes of the region was derived from the DEM of the province. Based on an analysis of provincial area, map of the slopes was divided into four levels of slopes.

A map of the soil of the province was obtained from the map provided by the country's organization for the protection of the water and soil. Therefore, all climatic factors such as digital elevation model, slope maps and regional soil were evaluated in the GIS environment.

RESULTS AND DISCUSSION

Climatic factors in combination are very influential in determining climatic potential for canola cultivation in different regions of Ardabil Province. Overall the amount of precipitation in most areas of this province and their distribution in different parts of the north west of the province as well as low temperature and extreme frost especially in Bostan Abad and Sarab are the main restrictions to the cultivation of canola in Ardabil Province (Fig. 1). Precipitation plays an important role in canola cultivation. From the point of view of amount of humidity canola requires at least 200 mm of annual precipitation. In this study for the purpose of determining the amount of humidity required for canola (Table 1), the amount of annual precipitation periods from all meteorological stations and meteorological stations of the water organization were prepared in the GIS environment and then converted to a DEM.

Based on the growth needs of canola appropriate weightage was given and from the combination of annual precipitation, precipitation during growth period, values of precipitation in Ardabil Province were prepared based on growth needs (Fig. 2).

Based on the obtained map from climatic factors and elements of East Arazbaijan province, suitable regions for the cultivation of canola were identified and based on the analysis of the final map about 17% without restrictions, 22% with some restriction, 23% with moderate restrictions, 18% with fairly severe restrictions and finally 18% with profound restrictions

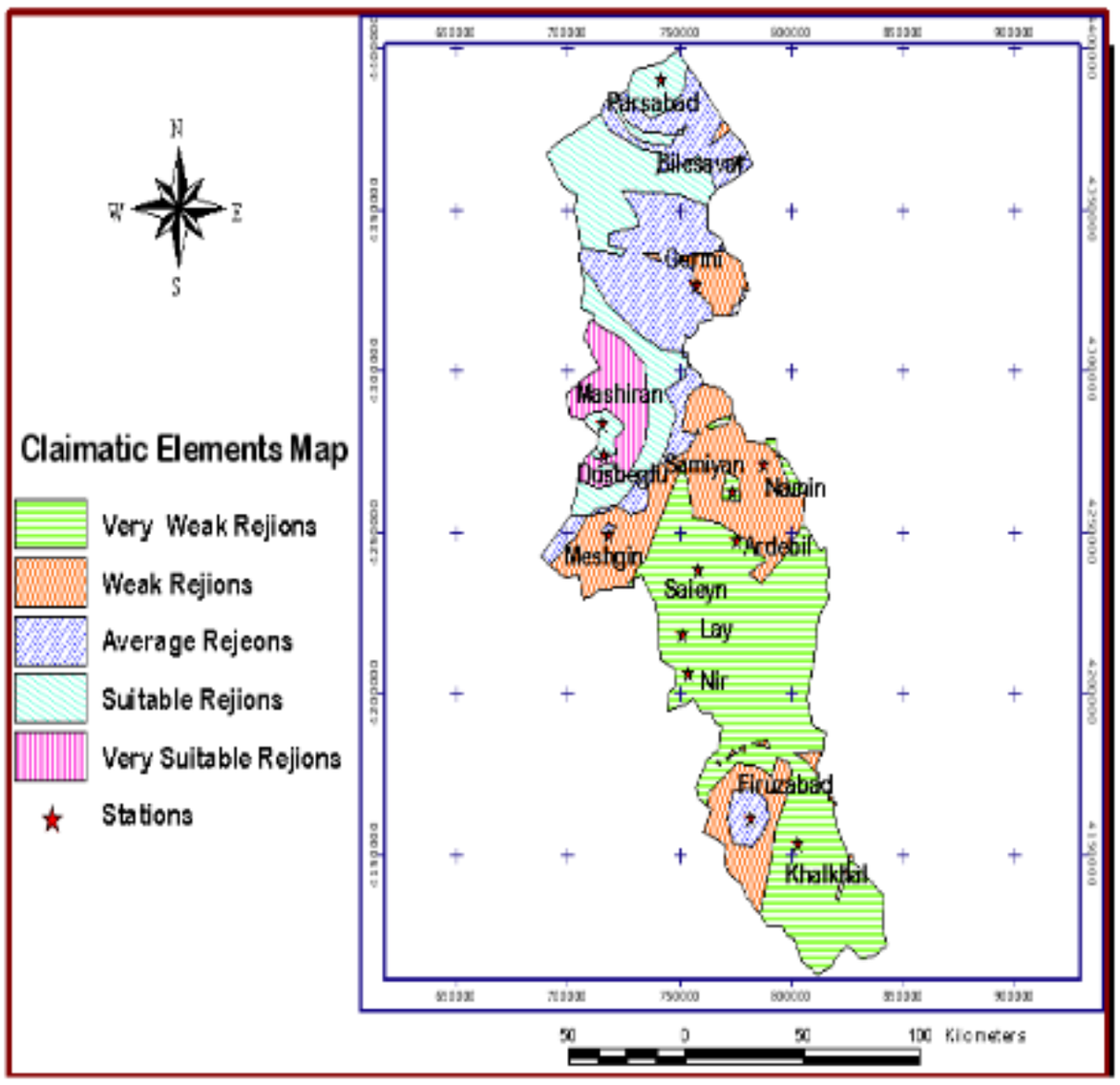

Fig. 1: Preparation of a map from the combination of maps relevant to elements needed for canola

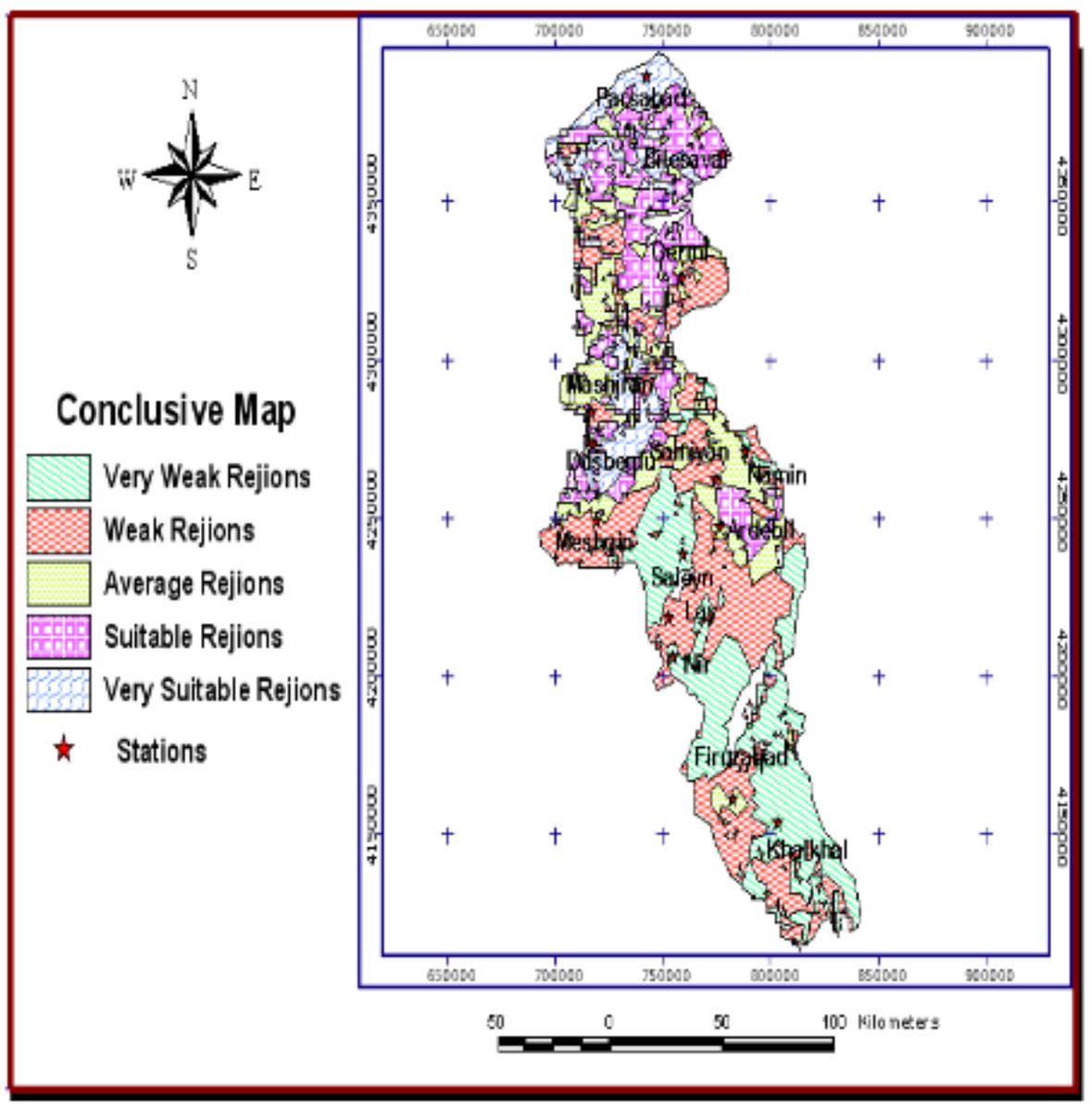

Fig. 2: Preparation of a map from the combination of maps relevant to factors needed for canola growth

were found to be suitable for canola cultivation (Fig. 3). It should be mentioned that about 2% of the region studied was considered to be salty area devoid of any conditions conducive to canola cultivation.

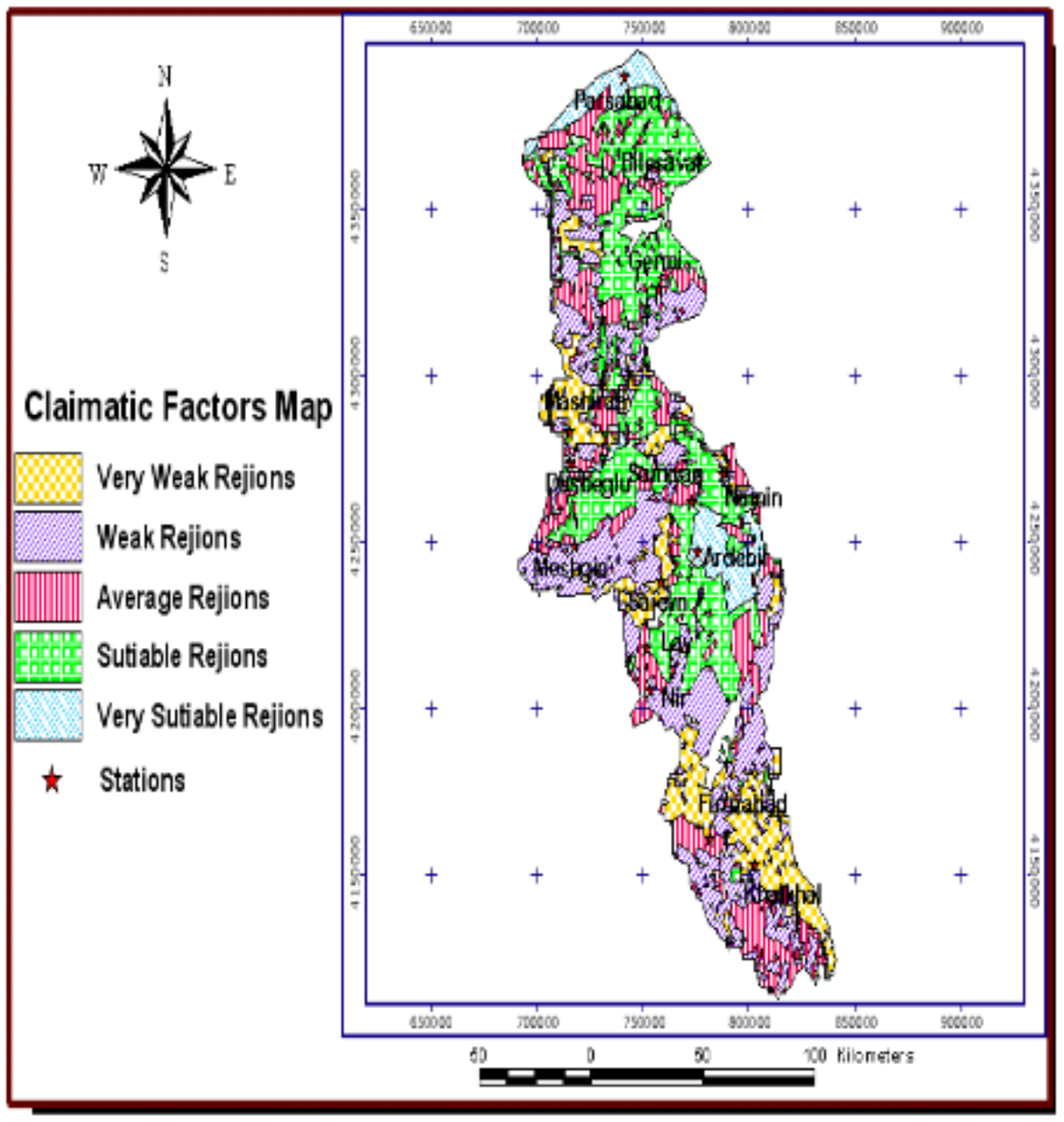

Fig. 3: The map was prepared from combining values of climatic elements and factors using the weight classification model and Boolean model

CONCLUSION

Although, about 35% of the region studied may be conducive to canola cultivation with some restrictions, only 10% of the region is favorable for canola cultivation without any restrictions.

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